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Bridging the gap between educational research and school practice through cooperation of university and primary school teachers

Katarina S. Wissiak Grm*, Vesna Ferk Savec

University of Ljubljana, Faculty of Natural Sciences and Engineering, Vegova 4, Ljubljana, Slovenia

Abstract

The existence of a gap between chemistry education research and teaching practice has been the topic of many discussions, and in recent years many efforts have been made to overcome this gap. In the present paper, we contribute to these efforts by reporting about collaboration between researchers and teachers in the PROFILES project from the perspective of university members. In the paper, we assert that primary school teachers must receive very concise and unequivocal instructions for their work in order to ensure that all parts of the project are performed correctly. Collaboration between researchers and teachers is only prosperous if both parties value their own knowledge.

Keywords: chemistry education research, gap between research and teaching practice, collaboration between teachers and researchers

1. INTRODUCTION

Research in chemistry education is much younger than research in modern chemistry. It began in the 20th century, which is when journals in this branch also started to be published (J. of Chem. Ed., since ~ 1920; J. of Res. in Sci. T., since ~1960; Int. J. of Sci. Ed., since ~ 1980, etc.). Since this time, chemistry education research has provided a great deal of data and has supported particular groups of professionals, especially those involved in curriculum development or assessment design. However, the question as to the success in reaching the central core of professionals – the teachers in the classroom – remains open. Considerable evidence indicates a continuing gap between research on effective teaching and teaching practice (Robinson,1998; Costa et al., 2000;

* Corresponding author.
Email address: katarina.wissiak@ntf.uni-lj.si

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Gilbert et al, 2002; De Jong, 2004; Nuthal, 2004). Research is often seen by teachers as too theoretical, too idealistic, or too general to relate directly to the practical realities of classroom life (Hiebert et al., 2002).

According to DeJong (2004), there are four main explanations for the gap between chemistry education research and teaching practice:

- *The need to survive issue*. Teachers believe that they do not have enough time to read research articles because they are already too busy with their teaching in the classroom. Researchers, on the other hand, are required by their universities to publish in highly ranked journals, whereas for teachers publishing in journals does not provide rewards in terms of 'research' output.
- *The mutual expectations issue.* Teachers may be prone to thinking that research should provide quick final solutions for their teaching difficulties, while researchers may believe that teachers are able to understand their reports and transform research outcomes into useful ideas for teaching.
- *The innovation strategy issue.* Chemistry education reforms have often been introduced by using the RDD-model (research, development, diffusion). According to this 'top-down' approach, research projects are launched at universities or other research institutes and the results obtained are used for developing new curricula and teaching/learning materials in separate institutes, which also oversee the further dissemination of the end products. From this perspective, the teacher role consists only of executing the new programs, therefore creating a sharp distinction between researchers and teachers. Instead, strategies that contribute to bridging the researcher-teacher gap should be implemented.
- *The research paradigm issue.* Over the past several decades, research programs for chemistry education have been strongly influenced by 'content-free' theories of teaching and learning. The conclusions of this research have tended to be very general. However, most chemistry teachers are faced with specific content-related difficulties in teaching and learning. This discrepancy also contributes to the persistence of the research-teaching gap.

Anderson (2007) summarizes the barriers preventing, and the strategies promoting, the bridging of the gap between science education research knowledge and its application in teaching practice. He highlights several strategies that can be used to alleviate this problem (see Figure 1), so that more lecturers apply the results of science education research, such as translating research findings into less scientific language, publishing teaching experience, involving teachers in action research, etc.

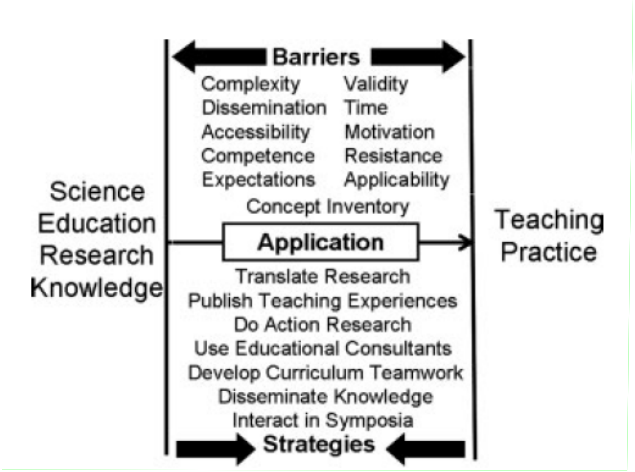

Fig. 1. Barriers preventing, and strategies promoting, the bridging of the gap between science education research and teaching practice (Anderson, 2007).

Most of the actions suggested by other researchers also refer to improving communication and collaboration between researchers and teachers (Gilbert et al., 2002). In order to improve such collaboration, numerous research projects are therefore being launched in which research teams are made up of researchers and teachers. One such project is PROFILES.

The PROFILES project is a 4-year Framework Program 7 (FP7) project funded by the European Commission of the EU (PROFILES Consortium, 2010). The PROFILES project promotes IBSE (Inquiry Based Science Education) through raising the self-efficacy of science teachers and thereby providing a better understanding of the changing purpose of teaching science in schools and the value of stakeholder networking.

Initially, PROFILES involves the development of lead teachers on four fronts (teacher as learner, as teacher, as reflective practitioner and as leader), consolidating their ownership of the context-led approach and incorporating use-inspired research, evaluative methods and stakeholder networking (Bolte, 2011).

In the present article, we report on the collaboration between researchers and teachers from the perspective of university members, based on experience gained in the first two cycles of collaboration in the PROFILES project.

2. METHOD

2.1 Sample

In the two years of the PROFILES project, 71 teachers have participated in the project, along with 10 university coordinators.

2.2 Instruments and materials

As result of the project, more than 35 modules have been developed over the two years in cooperation between university coordinators and school teachers, including several modules covering various learning objectives, with titles such as: “Why is vinegar used as limestone remover?”, “Why is it easier to swim in the sea than in a lake?”, “An apple a day keeps the doctor away”, “How does food containing different fats influence our body?”, etc.

As examples, some typical parts of the modules are presented in Figures 2–5:

Fig. 2. “An apple a day keeps the doctor away”

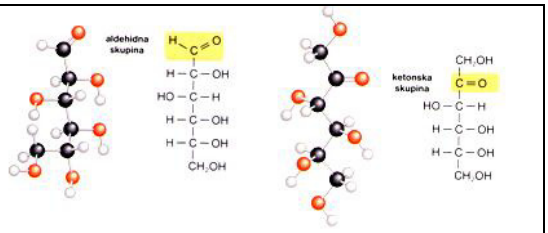

Fig. 3. Models presenting fructose and glucose molecules

1. DELOVNI LIST

HRANILA IN ŽIVILA

V človeški prehrani najdemo množico različnih živil. Med najpomembnejšimi so žita, iz katerih izdelujemo kruh in testenine, pomembni pa sta tudi sadje in zelenjava. Ta živila so po svojem izvoru rastlinska. Veliko živil je tudi živalskega izvora, mednje spadajo meso, mleko in mlečni izdelki ter jajca. Kaj vsebujejo vsa ta živila, zakaj jih jemo? Poglej na embalažo nekaterih živil in skušaj ugotoviti glavne sestavine. Te so navadno navedene v preglednici z naslovom »hranilna vrednost«. V spodnjo preglednico vpiši sestavine živil in druge pomembne podatke.

Fig. 4. "What does our food contain?"

Tabela 2

Čisti vitamin C	Št. kapljic jodovice
Vzorec 1 (10 mg vitamina C)	
Vzorec 2 (10 mg vitamina C)	
Vzorec 3 (10 mg vitamina C)	
Povprečno št. kapljic jodovice/10 mg vitamina C	

Fig. 5. "Vitamin C determination"

2.3 Procedure

The collaboration between researchers and teachers in the PROFILES project can be summarized in four crucial steps, which are presented in Figure 6 and described later in the article.

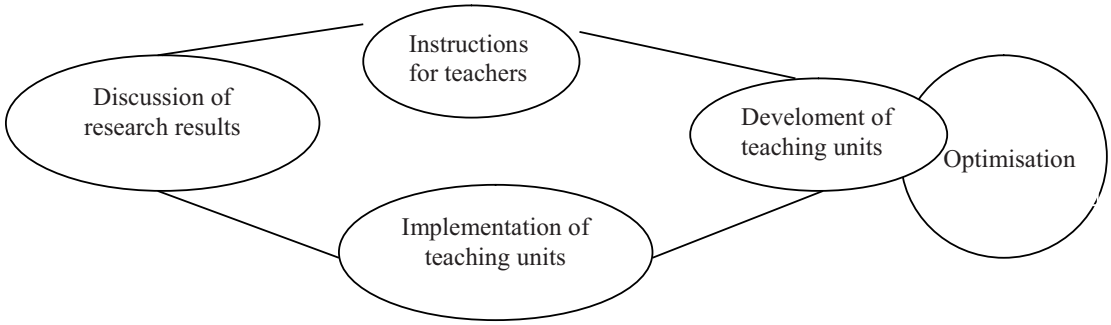

Fig. 6. Crucial steps of collaboration between researchers and teachers in the PROFILES project

2.3.1 Instructions for teachers

Since teachers had to design and implement four precisely structured documents (Instructions for Teachers, Instructions for Students, Pre-Test and Test), the university coordinators provided them with accurate instructions for each document separately, following particular project requests. Teachers received several sample teaching units (modules) on which they could base the design of their own modules. They also received written instructions for designing some specific parts of the module (e.g., experimental work).

2.3.2 Development of teaching units and optimization

The design of each teaching unit had to undergo several steps. Firstly, an initial draft had to be created in cooperation between the primary teachers and the university coordinator.

Each subsequent version of the teaching unit (module) designed by the group of primary teachers was sent to the university coordinator for the first revision. The university coordinator had to revise all of the teaching material belonging to a particular module, as well as giving the primary teachers appropriate feedback, focusing on both the content and the teaching methods included in the teaching unit. Based on the feedback provided by the university coordinator, the primary school teachers had to adapt all of the materials and submit them once more for final revision. The entire optimization process was performed several times in this way for each of the teaching modules conceived.

In the process of optimization, each teacher in the group had an opportunity to take part in a common discussion, and each part in the module was carefully examined together with the university coordinator. The university coordinators did their best to meet teachers' expectations and requirements regarding their common cooperation.

2.3.3 Implementation of teaching units

After the demanding process of module optimization, the resulting modules were finally implemented in school classrooms. Implementation of the modules was undertaken at different times in different schools. In the present research, classes in which designed and optimized modules were implemented as experimental groups were considered, while all of the other classes, in which teachers taught their students in their usual way, were regarded as control groups. During the intervention in school practice, several questionnaires were completed by all of the students involved in the research. Some of the questionnaires were completed in computer classrooms, while the teaching process was carried out in regular classrooms.

2.3.4 *Discussion of research results*

In general, significant differences were detected between groups of teachers regarding the process of further discussion and dissemination of the results obtained. Some teachers only discussed the results within their own group, while some of the groups gave public presentations of their work. The handling of the dissemination of project results was not determined in advance, but several recommendations were given regarding the importance of project result dissemination.

Participating teachers have an opportunity to continue with the work implemented, as in the following year they can become leading teachers in the PROFILES project. In this way, they have an opportunity to share their experience with the new teachers in the project, and to continue and enrich the work already done. Consequently, all of the teachers involved in the project have an opportunity to present the results of their work in public.

3. RESULTS AND DISCUSSION

Based on the experiences of the university coordinators, the following issues should be pointed out regarding effective collaboration with primary school teachers in the process of the development and evaluation of learning units:

3.1 Principal permission for cooperation in the project

In line with primary school protocol, primary school teachers must provide their principal with evidence of having gained permission for the students to collaborate in the PROFILES project.

3.2 Arrangements before the start of cooperation between primary school teachers and university members

University members are aware that primary school teachers need to receive well-structured and accurately written instructions in order to start developing teaching units. The instructions must be presented in a way that offers very concise step by step instructions, but at the same time must permit a broad enough perspective for the primary teachers to gain an insight into the global concept of the study, according to the "PROFILES philosophy". However, based on the experience obtained in the two years of project implementation, university members have recognized that it is of the utmost importance to go into further detail at every step of the project.

3.3 Design of the students' and teachers' material

Due to a lack of time, primary teachers sometimes constructed teachers' and students' instructions at the last minute. In practice, this resulted in students' and teachers' instructions that were not written simultaneously and concisely. Since they were written separately, delayed teachers' instructions caused several inconveniences for university coordinators in terms of receiving the relevant information for the evaluation. When they failed to receive documents on time, university coordinators were frequently in doubt as to what exactly teachers meant with a specific task in the instructions for students. Consequently, the implementation of the module had already been completed before the discussion between the university coordinators and primary teachers could take place.

3.4 Design of the pre-tests and tests

Designing pre-tests and tests requires a very accurate and precise picture in the teacher's mind. We have to know what the desired result of the teaching unit (module) is. More precisely, we need to be clear about what we really want the students to have learned after performing the teaching intervention. As soon as this perception is clarified, we can start considering the test design. Before we can start structuring the individual test tasks, however, the key words from the module content must be determined at the very least. In designing every single task in the test, teachers must be very aware of keeping in line with the content of the teaching unit. They have to consider very precisely all of the new information students encounter in the implemented unit, so that the test covers all of the relevant content included in the module. The pre-test must be constructed in a similar way, taking into account the teaching content students have already learned.

3.5 Respecting the members involved in the project and consideration of revisions

In the development process of the teaching units, the material designed by the primary teachers underwent several optimizations, carried out by university members. Regardless of the work on both sides being time consuming and quite demanding, the desired result was sometimes not achieved in the end. In some cases, modules were brought into the classroom with complete disregard for the final revision of the university coordinator. In future, it would be beneficial to put together a simple code for teachers' cooperation, stating that the process of development and optimization of the teaching unit will be repeated until consensus is reached on the teaching module. Only in this way can we achieve the common goal of bringing a revised and adjusted teaching unit to the classroom.

3.6 Blank forms for the evaluation of project results

In general, primary school teachers are experts in their own field. Considering this fact, university members must pay special attention to providing them with concise instructions for the specific phases of the research project work. Primary school teachers like to receive concise and complete forms that they can complete with the research results obtained in the project. However, they are also pleased whenever university members can assist them in completing various tasks.

3.7 Organizing meetings of all of the teachers involved

In spite of the fact that we live in the Internet era, it is very important to provide an opportunity for all of the teachers involved in the project to meet "live". Such meetings provide an appropriate atmosphere for teachers to have a chance to talk to each other, to share their experiences and to overcome the difficulties confronted along the way, in order to successfully fulfill their project expectations.

Over the two years of the project implementation, over 15 such "live" meetings were held. Nevertheless, e-mail communications and web-based learning were provided from the start of the PROFILES project implementation and continued throughout.

3.8 Encouraging primary school teachers to write a portfolio

During the PROFILES project implementation, primary school teachers were encouraged to keep a written record whenever they felt the need to make note of a specific observation, perception, hesitation or conclusion, regardless of the phase of the project. In their portfolios, teachers expressed their views and concerns, as well as their positive experiences with the development and application of the modules. The portfolio serves two purposes. The first is procedural, developing science teachers' reflection, encouraging their professional development and self-concept, and improving the quality of learning and teaching. The second is evaluative, with the portfolio functioning as a tool for science teachers to present their pedagogical competences and knowledge of the new professional experiences related to the project goals, through a process of action research following the main principles of the PROFILES approach (Devetak et al, 2012).

3.9 Stimulating primary school teachers to disseminate their work

Primary school teachers were encouraged by the university members to present their work throughout the PROFILES project. Some of them have also had the opportunity to contribute to the 1st International PROFILES Conference, which was held in Berlin in 2012 (Šket, B., 2012).

4. CONCLUSION

From the perspective of the university members, the experience of collaboration between researchers and teachers in the PROFILES project in first two cycles has been encouraging.

In order to ensure smooth collaboration, we found that primary school teachers must receive the instructions needed in a complete, concise and entirely determined form. There is a large group of different people involved in the project, including students, primary teachers, university members and other collaborators. All of them have their own expectations, needs, timetables, styles of working, attitudes, etc. Therefore, not a single stage of the project can be left to chance. Consequently, the appropriate conduct of all of the members involved is needed in order to carry out all of the phases of the project correctly and completely. Common tasks must be determined in advance, so that all of the people involved are aware of what they have to do to reach the common goal.

Although the university members were aware that the primary school teachers needed to receive well-structured and accurately written instructions, the modules designed by the teachers indicate that the instructions need to be even more concise. In order to develop teaching units that are more "user friendly" – primarily for the students, but certainly for the teachers as well – very concise step-by-step instructions should be provided by the university coordinators. The result should be modules that are brief, concise and provide students with intelligible explanations of the learning and teaching content.

Regarding the preparation of the evaluation material in the future plans of the PROFILES project, it would be beneficial to include the aim that teachers should acquire basic knowledge of test design. Given that teachers have to prepare evaluation instruments on their own for use in the classroom before and after the intervention, they would probably be grateful for the insight provided by such knowledge.

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